A Framework for Informal STEM Education Outreach at Field Stations

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Field stations across the United States provide learning opportunities to the general public through their outreach programming. With approximately 78% and 98% of the US population living within 60 and 120 miles of a field station, respectively, stations have the potential to be key providers of informal STEM education. We surveyed a sample of US biological field stations and asked them to describe their outreach programming and goals. Our findings indicate that field stations prioritize outreach by dedicating personnel and fiscal resources, but such initiatives are highly variable in magnitude and scope. We propose an informal STEM education framework to guide outreach efforts by aligning place-based activities with outreach goals, strands of science learning, and learner engagement theories. Such intentional program design can help stations focus on meaningful learning outcomes for their outreach participants.

Keywords: informal learning, biological field stations, outreach programming, STEM education

Field stations are an excellent venue for educating the general public about science in the United States but are often undervalued and unrecognized (NRC 2014, Baker 2015). They have existed for more than a century; the oldest inland station, the Forbes Biological Station, in Illinois, dates research activities back to 1894 (Havera et al. 2003, Tydecks et al. 2016). Although there is great variety in field stations in terms of size, location, and purpose, they all have four main functions: to provide access to the environment, to provide logistical support for a wide range of activities (scientific research, student training, and outreach), to establish a model ecosystem, and to foster a community of scholars (Billick et al. 2013). Primarily established by universities and governments to serve researchers and students conducting fieldwork, stations do recognize the importance of providing informal science, technology, engineering, and mathematics (STEM) learning programs to the general public (Billick et al. 2013). In a report envisioning the future of field stations and marine laboratories (FSMLs), one goal is to "increase the value to society of the science done at FSMLs, as well as the public understanding of that value" (Billick et al. 2013). A key way to meet this goal is by documenting, improving, and increasing the number of educational activities provided by field stations to broad audiences (Klug et al. 2002).

Accordingly, we have begun to study outreach programming at field stations and how such endeavors work in practice. Field stations are special because they primarily serve the research community so any outreach efforts to the lay community have the potential to expose learners to ongoing, long-term, scientific research. Interactions with STEM professionals are valuable for disseminating scientific knowledge and connecting the lay population to science and nature through hands-on, experiential, discovery-based learning. Case studies can be extremely useful for understanding the impact of individual programs (e.g., Riedinger 2015, Flowers and Beyer 2016, and Janovy and Major 2009), but little is understood about the collective efforts of field stations to provide learning opportunities to the general public.

In 1997, the National Science Foundation added a clearer broader impacts requirement to grant proposals, asking scientists to consider the impact of their work on society and engage nonscience communities more than before (NSB 2011). Field stations can help fulfill this funding obligation by bringing scientists and the public together more easily than other research institutions. Although the growth of outreach programming specifically targeting public audiences at field stations is unknown, most people in the United States have a field station within reach of a family activity or school field trip. In ArcMap v.10.2.2, we used census data (USCB 2016) and radial buffers to estimate that approximately 78% and 98% of the US population live within 60 and 120 miles of a field station, respectively. Given the proximity

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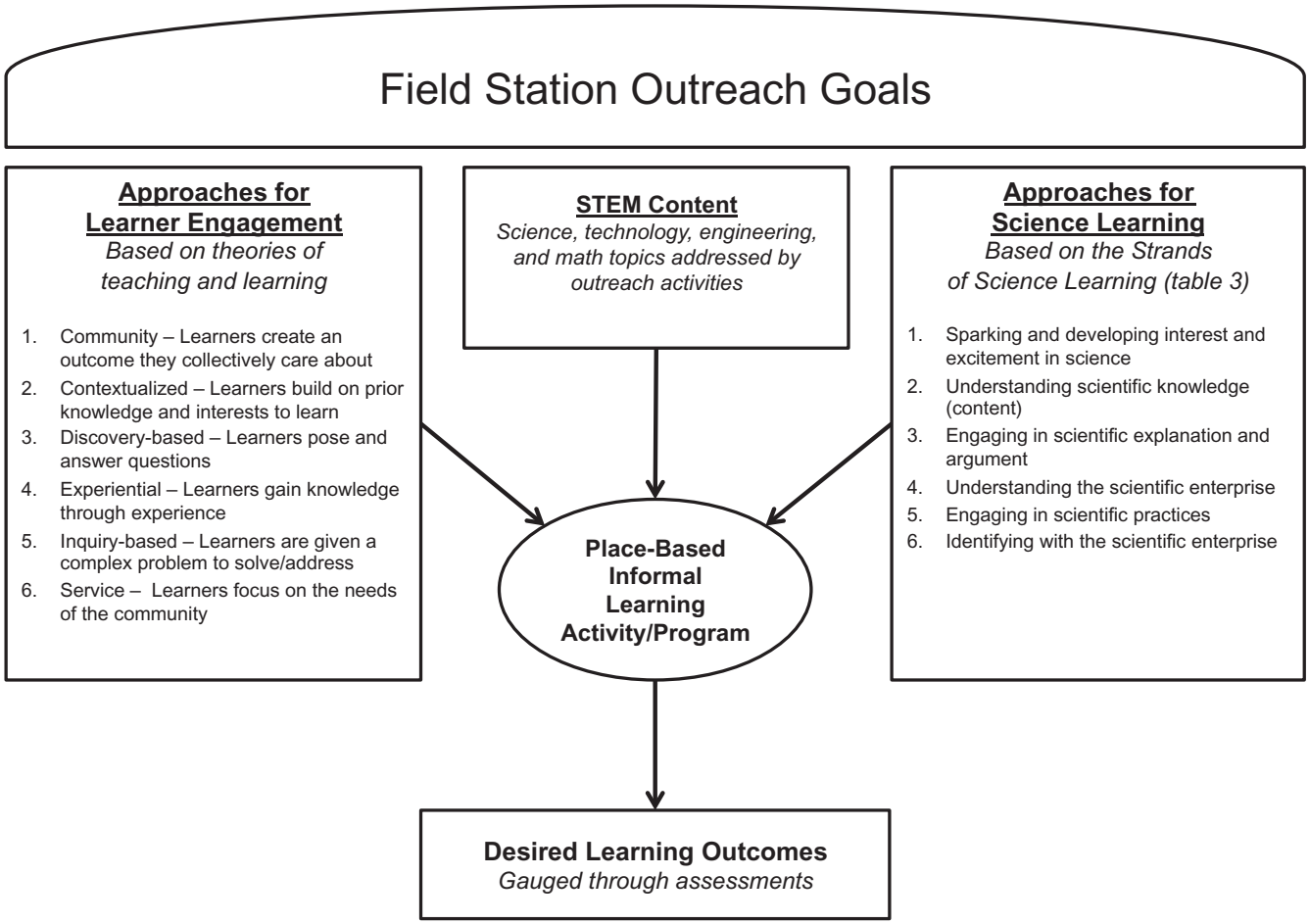

Figure 1. Informal STEM learning framework.

of field stations to the general population, such efforts create tremendous opportunity for a particular type of meaningful outreach programming: informal STEM education.

Informal STEM learning is potentially "lifelong, life-wide, and life-deep" (NRC 2009) because experiences can be designed for learners of all ages, across a broad range of social settings, and within a cultural context. Informal learning programs are voluntary and are driven by participants' curiosity about their surroundings but the details may vary widely. Whether taking visitors on a guided nature hike, inviting nonscientists to engage in scientific research, or supplementing K–12 curricula with hands-on activities, field stations provide informal learning experiences connected to a specific geographic location.

As we describe in detail in this article, a surveyed sampling of field stations revealed that they do offer a variety of outreach programs, but they differ widely in their understanding and implementation of outreach. Moreover, there is currently no informal STEM education framework for understanding such efforts among field stations. We propose such a framework, based on a survey of field stations about their outreach, and explore how it can be useful for stations that seek to engage learners of all ages with science knowledge (figure 1). The framework centers place-based informal learning activities and programs as a means to achieve desired learning outcomes given STEM content, approaches for learner engagement, and science learning. The framework should be viewed in the context of individual field station outreach goals. On the basis of survey results, we constructed an operational definition of outreach as any effort by field stations to promote public awareness of STEM knowledge through informal education. In the following sections, we discuss field stations and their outreach goals and capacities, as well as their outreach activities and program assessments. We also present and explain the place-based informal STEM education framework.

Field stations

In addition to their function as scientific infrastructure (NRC 2014), field stations are a valuable resource because they provide personal and communal experiences in nature, which foster exploration, a sense of discovery, and environmental stewardship (Eisner 1982, Wilson 1982). Billick and colleagues (2013) define field stations and marine labs

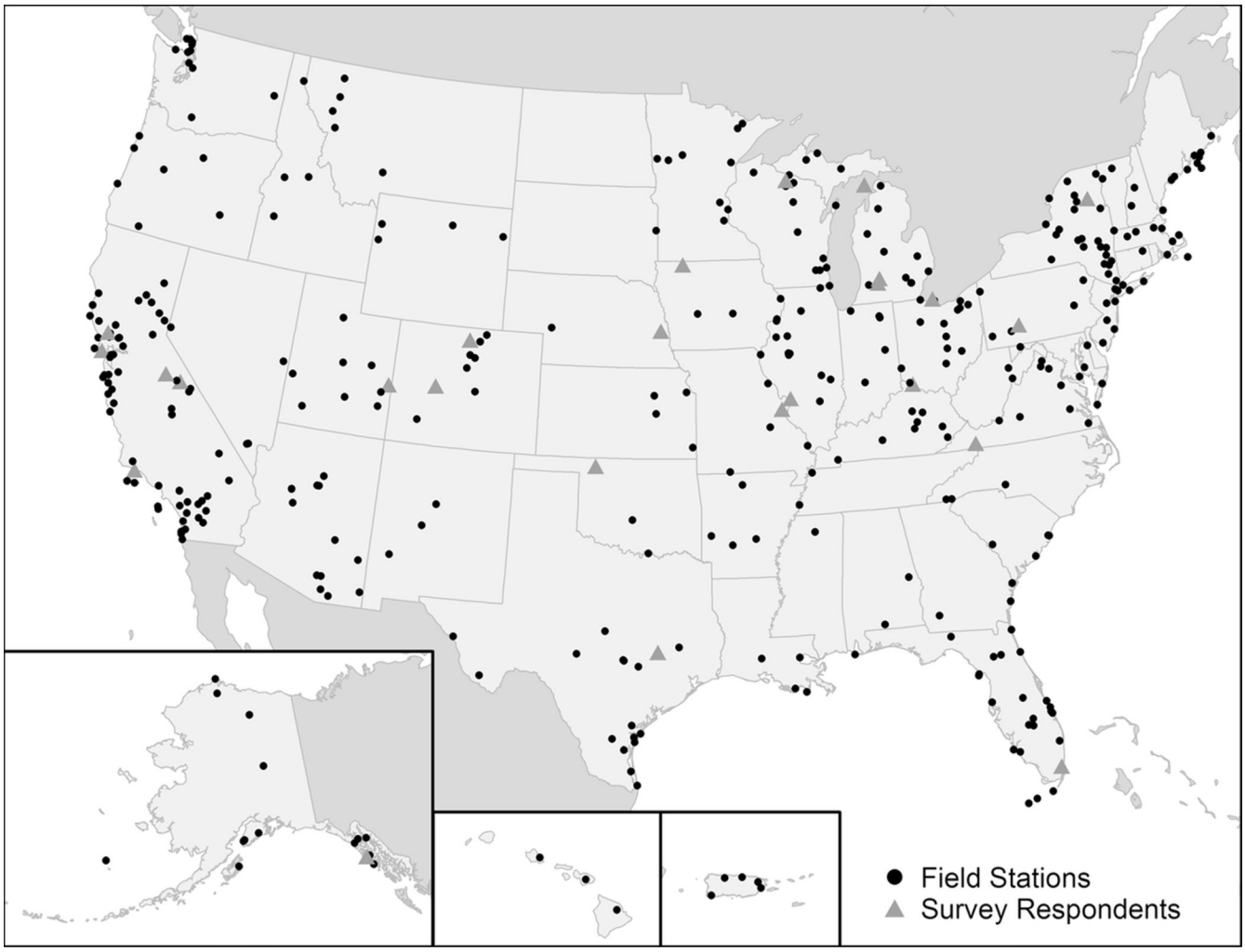

Figure 2. Field stations in the United States (N = 406).

broadly as "facilities that support sustained place-based research on environmental processes." In our research, a field station is operationally defined as any establishment that calls itself such and supports scientists conducting research on or near its premises. This definition is intentionally broad and encompasses any institution that sees itself as serving the research community in a specific location. On the basis of a review of Tydecks and colleagues (2016) as well as the directory information listed on the website of the Organization of Biological Field Stations (OBFS; OBFS 2016), we estimate that there are approximately 400 field stations in the United States (figure 2).

Field stations vary greatly in size, purpose, and management structures (Billick et al. 2013). Some may consist of a single building and offer resources for visiting scientists, whereas others have a sizeable full-time staff, multiple buildings for research, and can support hundreds of overnight visitors. Management structures come in a variety of forms, but there are four types of institutions or organizations in the United States that operate field stations either completely or in some combined partnership: national parks and governmental institutions; nonprofit and private organizations; universities and colleges; and research institutions, academies of science, and museums (Tydecks et al. 2016). Consequently, field station resources differ considerably and can limit the scope and magnitude of field station outreach. Some stations can support staff dedicated exclusively to outreach activities, whereas others primarily focus on supporting scientists in their fieldwork and may provide minimal outreach programming, if at all.

Field stations have attracted a large number of visitors over the years. Stevens and Gilson (2016) showed that just eight field stations attracted an average of 8340 visitors annually. Although these field stations are located in national parks that help attract visitors, their large numbers of annual visitors indicate that there is public interest in visiting places in which field stations are situated. In addition to field station personnel and those involved in formal education programs, including scientists, scholars, and university students, field stations educate and influence

scores of school children, members of the local community, and adult learners.

Field station survey

To begin understanding outreach programming at field stations we designed an online survey asking field station personnel to report on their resources and provide details on their outreach activities. Between August and October 2016, the research team solicited members of OBFS to complete a survey about field station outreach activities. Figure 2 depicts the locations of the 25 US field stations whose representatives completed the survey. The person who completed the survey was always someone with a thorough knowledge of the station's outreach activities—usually a field station director, an outreach or education coordinator, or a conservation specialist.

The survey was designed to answer three research questions: How are field stations defining outreach? Do field stations have active outreach programs and in what ways are they a priority for the station? And what teaching and learning do the participants experience through field station outreach offerings? Accordingly, the survey asked field stations to describe their mission, purpose, funding, affiliations, and size (e.g., the number of personnel, the annual outreach budget, resources, and the number of visitors or program participants). The respondents were then asked to detail their outreach programs, including activities offered, targeted audience, STEM content area, curriculum design, and implementation strategies. If programs were assessed, field stations were asked to report that as well. The survey instrument and collected data are available as supplemental material.

The field stations that responded to our survey questions account for approximately 6% of recognized US field stations and are primarily affiliated with universities or colleges (76%) as are most US field stations according to the data compiled by Tydecks and colleagues (2016). Other affiliations include nonprofit and private organizations (24%), Governmental institutions and national parks (4%), and research institutions, academies of science, and museums (4%), with some stations indicating multiple affiliations (8%). Whereas most of the US population lives near at least one field station, we estimate that approximately 11% and 33% of the US population lives within 60 and 120 miles, respectively, of the 25 field stations we surveyed. Most of these field stations host less than 10,000 visitors annually, but one hosts nearly 80,000 visitors; cumulatively, they host 250,000 visitors each year.

Outreach definitions

To seek a shared understanding of outreach, we asked the respondents to define outreach as the term applies to their field station. Some stations described specific programs and others described their general approach to outreach, some focused on targeting specific types or categories of learners (e.g., age or interest groups), and others honed in on the informality of the learning experience. For instance, the Bonderman Field Station at Rio Mesa works to involve nonscientists in science, with an emphasis on students. They summarized their outreach work this way: "For our station, due to its remoteness, outreach often occurs by supplementing for-credit course activities with experiences that are unrelated to course content. For example, [we offer] opportunities for art students to participate in a morning of bird banding or an evening of stargazing and astronomy discussions. These opportunities expose users to science and methods of inquiry distinct from the content of the for-credit course in which they are participating, in ways that they likely would not have sought out on their own." Such programming targets nonscience students and forms the basis of the field station's outreach activities.

A common thread through all field stations' responses was that outreach is informal education and targets a particular audience or community. As introduced earlier, our analysis of these responses has lead us to define outreach operationally as any effort by field stations to promote public awareness of STEM knowledge through informal education. Given this definition, we are better positioned to evaluate the role of outreach in the mission statements of field stations and the scope of outreach as a priority for field stations.

Outreach goals and capacities

Most field stations described their mission to support scientists and students by providing research opportunities and resources. Every field station surveyed included or implied a commitment to outreach in their mission statement. When asked to describe the goals of their outreach programs, 80% of surveyed field stations described their outreach goals in terms of the target audience such as K–12 students, only high school students, only college students, adults, families, and the local community (table 1). Field stations also emphasized the knowledge and skills gained by the participants through the outreach programming (52%), which could be very specific (e.g., maple-syrup-making processes) or very broad (e.g., advance knowledge and skills).

The goal to build community, articulated by 20% of stations, encompassed any mention of working with community partners or strengthening community relationships. Field stations with the goal to raise awareness of the field station's work (16%) were interested in publicity so that the community recognized them as a resource. For example, the Selman Living Lab in Edmond, Oklahoma, seeks to "be known in the area and across the state as a great place to learn something new about the environment."

Some field stations mentioned developing field station resources for outreach purposes (12%), which may include specific facilities or development projects, or generally considering the field station to be a resource for the outreach participants. In addition, some field stations indicated that their programming should inspire youth to pursue a career in STEM professions (12%), such as the goal of Point Blue's Palomarin Field Station in Bolinas, California, "to expose

Table 1. Themes of field station outreach goals.

Outreach goals	Percentage of surveyed field stations
Reach a particular audience (e.g., K–12 students, the general public or all ages, diverse populations)	80
Disseminate knowledge and skills	52
Teach about the environment generally	44
Encourage conservation or environmental stewardship	40
Build community	20
Raise awareness of the field station's work	16
Make field station resources available to the public	12
Motivate STEM careers	12
Inspire curiosity	8

Note: Goals are not mutually exclusive and most field stations indicated multiple goals as well as multiple audiences. These percentages reflect responses from 25 stations.

students to science as a career" and Yosemite Field Station's Yosemite Leadership program that "connects minority college students with career internships in the park." Finally, a few field stations aimed to inspire the participants' curiosity and interest in their surroundings (8%), such as the Pepperwood Preserve, with the goal "to pique curiosity about the natural world in children of all ages and from diverse backgrounds."

Responses from the 25 US field stations indicated substantial capacity for informal education programming at field stations. In the present article, we judge capacity on the basis of available land, structures, equipment, scientists, dedicated staff, and other resources. Resources typically dedicated to either scientific or outreach purposes may be used to support the other, or the two endeavors may use the same resources at the same time. Of the 25 field stations, 20 have staff or volunteers dedicated to outreach activities. Some stations have one full-time employee devoted to outreach, but others rely on part-time employees or volunteers to implement their outreach (figure 3). Budgets dedicated to outreach vary from less than $5000 (four stations) to greater than $100,000 (six stations), which may be indicative of considerable variation in what stations can offer (figure 4a).

To determine how much of a field station's work is dedicated to outreach, stations were asked to estimate the percentage of their programming dedicated to research or graduate student training, formal education (e.g., for-credit courses), and outreach (e.g., volunteer, nonaccredited courses, community service, or informal education). Although the percentage of total programming dedicated to outreach activities varied across all field stations, seven dedicate more than 50% of their programming to outreach and the median field station in our survey dedicates 37% (n = 22) of its programming to outreach (figure 4b).

Outreach activities and program assessment

We asked stations to discuss their outreach programming in detail, including targeted partiZcipants, the content topics, corresponding activities, and ways in which stations assess their programming. We requested information on up to five outreach activities or events and our survey resulted in a total of 73 activities reported from 20 of the field station respondents. Although casually hosting visitors alone could constitute outreach, the majority of the respondents indicated that an outreach programming goal is to attract specific audiences (table 1). Most activities reported by field stations in our survey recruit all ages, followed by adult learners and youth (figure 5).

The STEM content areas covered by field stations' outreach activities are also highly variable. General science knowledge was the topic of 62% of the reported activities and 26% of the activities dealt with environmental, conservation, and ecological topics. Activities ranged from general science seminars to summer youth internships and camps (table 2), which generally align with the previously described goals of disseminating knowledge and skills, teaching about the environment, and encouraging conservation or environmental stewardship (table 1). Of the 73 documented outreach programs, the described content of 29 (40%) explicitly reflected aspects of each field station's unique location, aspects of the local community, or the specific work being conducted by researchers at the field station.

Assessment is key for ongoing program improvement as well as for securing funding and other supports from stakeholders. The stations used a variety of assessment methods, and often more than one type of assessment was applied to the same program. Measuring participation levels (59%) was most favored, followed by administering a survey or questionnaire (44%), and observing the participants experiencing the programming (42%). Fewer stations reported assessments based on products of the outreach activities (18%) and testing assessments were used least (8%). Although some stations reported no program assessment at all (8%), others followed up on a survey with interviews (4%). The stations that indicated very structured assessment strategies for outreach activities on the survey are working in partnership with or

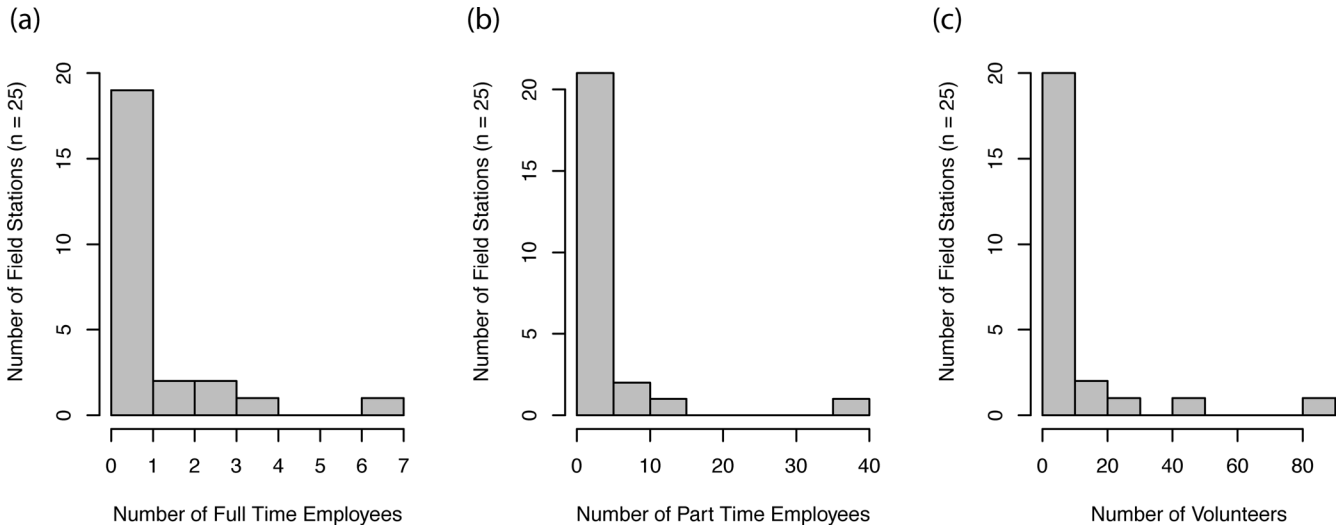

Figure 3. Personnel at field stations who are dedicated to outreach programming: the number of (a) full-time employees, (b) part-time employees, and (c) volunteers.

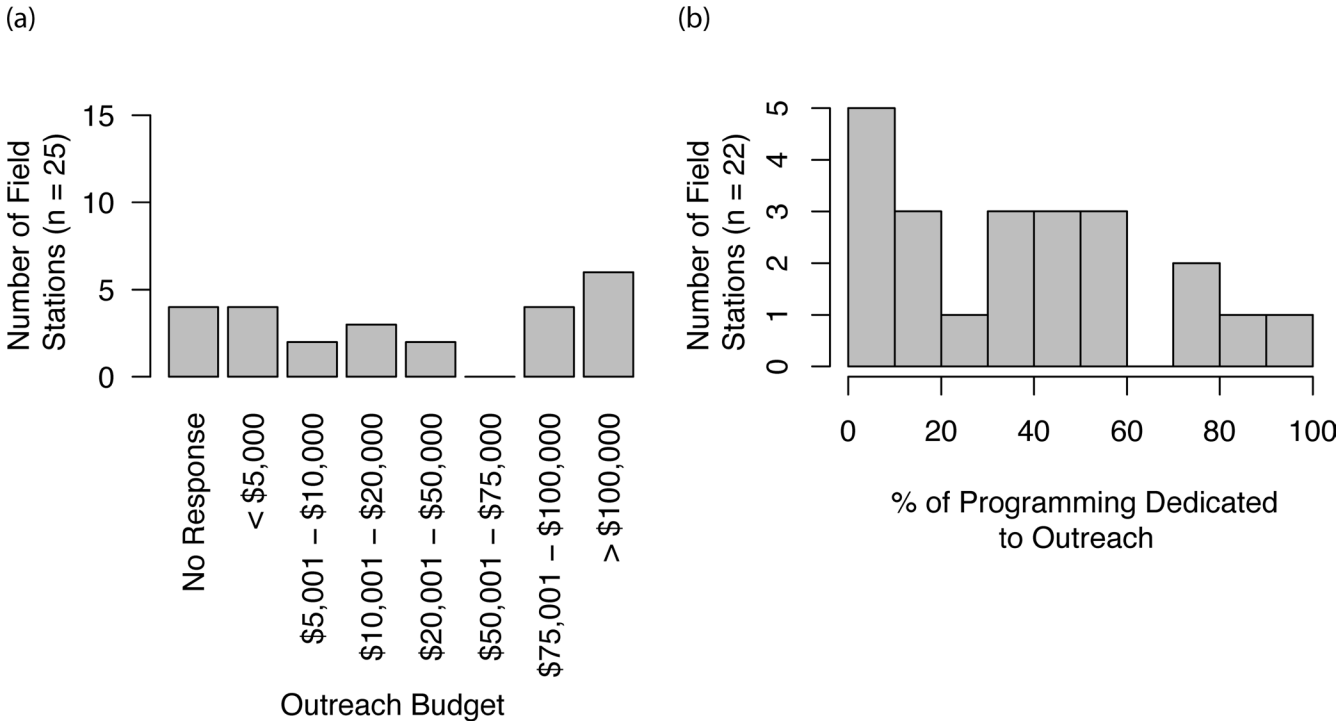

Figure 4. Field station resources dedicated to outreach: (a) outreach budget and (b) the percentage of total programming.

reporting to formal education institutions, such as K–12 schools or university researchers. For stations operating programs independently, assessment varied widely and none reported long-term tracking of participant progress on the topics addressed in the outreach program. Perhaps reflective of these trends, 73% of the field stations in the survey desired better methods to document, evaluate, and synthesize outreach practices, and 68% of the field stations indicated that it would be extremely useful or very useful to have access to existing assessment tools.

A place-based informal STEM education framework

Place-based informal learning activities and programs are at the heart of all field station outreach programming.

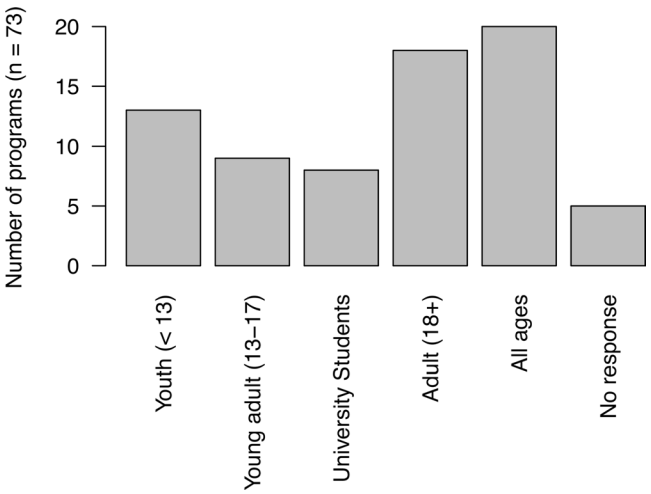

Figure 5. The targeted age groups for outreach programs reported by field stations.

On the basis of the survey findings, we conclude that there is a need for a conceptual framework to understand and guide field station programs across place, content, activity, and assessment while aligning with overarching field station goals. Figure 1 depicts an integrated framework that includes approaches for learner engagement, STEM content, and the NRC's (2009) six strands of science learning coming together within the context of informal place-based programming offered by field stations.

Approaches for learner engagement. Careful review of the place-based activities reported by field stations revealed that six types of learning approaches engaged the participants in the field station environment: community, contextualized, experiential, discovery based, inquiry based, and service. Community learning involves an existing or new community coming together to increase their knowledge on a topic of interest to them so that together they can learn how to create an outcome they care about (Falk and Harrison 1998). Programs that use contextualized learning focus on knowledge that the participants bring with them and pushes them to consider how to apply that knowledge in a new situation (Rivet and Krajcik 2008). For example, the 2-day W. K. Kellogg Biological Station event called Grazing School is designed for farmers to learn more about managing grazing systems. This event promotes contextualized and community learning by bringing members of the farming community together to improve on an activity all of the participants care about (feeding dairy animals) and increases their capacity (as a community and individually) to manage their lands. Similarly, the Shaw Institute for Field Training program at Washington University's Tyson Research Center helps to increases STEM learning through contextualized learning by showing how scientific knowledge can be transferrable between situations.

Experiential learning activities provide learners with experiences that emphasize the learning process, not outcomes (Kolb 1984). At field stations, this might mean a hands-on experience to teach critical thinking tools used by scientists to test hypotheses and solve problems. When learners work independently to gain conceptual understanding by posing and answering a question, they are experiencing discovery-based learning (Alfieri et al. 2011) and if they are provided a perplexing problem with scaffolding and guidance, they are engaging with inquiry-based learning (Hmelo-Silver et al. 2007).

These different learning theories may complement each other and work better with some STEM topics than others. The Pepperwood Preserve's program, Students Conducting Environmental Inquiry, brings discovery-based learning together with experiential learning by asking the participants to make observations about the Preserve's flora and fauna, and to then pose questions about their observations. For activities that use the service learning approach, the participants study issues important to a particular community such as water or air quality, discuss how such findings might affect daily life, and work to enact a solution of some kind (Bringle and Hatcher 1999).

These examples illustrate the variety of approaches for learner engagement field stations incorporate in their outreach activities. Finding ways to facilitate meaningful learning experiences takes planning and staff or volunteers who are skilled at teaching nonscientists. These are investments field stations need to make to be successful providers of informal STEM education.

The six strands of science learning. The six strands of science learning framework was developed by the National Research Council (2009) to articulate six competencies in science and describe what learners do in informal learning environments (table 3). The six strands are meant to serve as a tool for research, practice, and evaluation of informal science learning. Our analysis of the survey data shows that outreach activities align well with all six strands of science learning.

Experience excitement to learn about phenomena (strand 1) and developing an identity as one who learns science (strand 6) are especially relevant to informal STEM learning experiences because, by design, they should motivate the participants to engage with science (NRC 2009). Creative programming, such as maple syrup making at the Raystown Field Station in central Pennsylvania or a science cruise at the Central Michigan University Biological Station, brings science topics to learners through activities designed to excite them. In addition, informal activities should develop the participants' interest in and excitement about science by asking the participants to be a part of the scientific process in some way. The Science on the River program at the Thomas More College Biology Field Station, for example, offers different hands-on STEM learning opportunities to youth under 13, and it addresses both strand 1 and strand 6 through its curriculum designed to have the participants

Table 2. Outreach activity types with examples from surveyed stations.

Outreach activity type	Field station	Example
General science seminars	Thomas More College Biology Field Station	Lectures provided by professionals to the general public
Camps	Rocky Mountain Biological Laboratory	Youth Programs—Seedling Scientists, nature and science camps
Lecture series	Adirondack Ecological Center	Huntington Lecture Series
Community events	W. K. Kellogg Biological Station	Wild Wednesdays—family-oriented learning events
Family science programs	Central Michigan University Biological Stations	Children's Field Trip—snake ecology and aquatic surveys
Citizen science projects	Pepperwood Preserve	TeenNat—participation in conservation science research
Hands-on workshops	Selman Living Lab	Public workshops on various living organisms
Station open houses	Trout Lake Station	Trout Lake Station Annual Open House
Nature walks	Coal Oil Point Reserve	Volunteer tour guides lead community members on a 2-hour tour
Demonstrations of research	Palomarin Field Station	Guided bird banding demonstrations
Summer youth internships	Yosemite Field Station	Connecting minority college students with career internships

Table 3. The six strands of science learning (NRC 2009).

Strand	Definition
1	Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.
2	Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.
3	Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.
4	Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.
5	Participate in scientific activities and learning practices with others, using scientific language and tools.
6	Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science.

actively doing science by testing water quality or collecting macroinvertebrates.

Understanding scientific knowledge (strand 2), engaging in scientific explanation and argument (strand 3), understanding the scientific enterprise (strand 4), and participating in the scientific process (strand 5) come together when outreach activities ask the participants to apply scientific knowledge in some way. For example, the Snowy Plover Docent Program at the Coal Oil Point Reserve aligns with strands 2 and 3 by training the participants of all ages to educate the public about the threatened Western Snowy Plover. At the Thomas More College Biology Field Station, the Citizen Science program aligns with strands 4 and 5 by preparing volunteers to work with a local watershed project. Another program at Point Blue's Palomarin Field Station teaches its participants of all ages how to band birds (strand 5) and connect science to conservation (strand 3). When outreach programs express these characteristics, field stations engage learners with STEM content and are able to better bring science-specific learning into the experience.

Desired learning outcomes and assessment. By asking stations to consider their STEM content and methods for engaging outreach participants, as well as the six science strands, they can better develop programming with clear learning objectives. These objectives can then be assessed through observation, questionnaires, or activity results, or in some other way depending on the station's outreach goals. There are existing resources regarding the assessment of informal STEM learning. For example, Friedman (2008) provides educators with a useful table and discussion of the types of impact on the participants a quality informal educational program might generate. Similarly, the Center for Advancement of Informal Science Education (CAISE 2011) provides a guiding framework for evaluation. The present framework promotes structure and emphasizes connections among the content taught and the strands of science to create opportunities for assessing participant learning regardless of the type of activity or how it is implemented. Moreover, by suggesting ways to engage learners, field stations can consciously consider how they best interact with the participants to achieve their desired outcomes.

Conclusions

There is clear evidence that field stations are engaging in activities that promote awareness of STEM knowledge to the general public through informal learning experiences. Moreover, they are prioritizing these activities on the basis of their mission statements and goals, as well as outreach offerings and dedicated resources. The survey respondents clearly have an interest in outreach and are motivated to discuss their outreach efforts; therefore, they may not be representative of the culture at all field stations. Even with

this potential bias, the analysis indicates there is a great deal of variation in field station outreach offerings. Falk and colleagues (2012), in their mapping of the informal science education community, conclude that informal learning providers are prioritizing societal improvement by focusing efforts toward increasing science literacy, connecting science to everyday life, and promoting environmental stewardship. With many surveyed field stations reporting that these are also goals of their outreach programming (table 1), field stations should be considered informal learning providers and included in that landscape.

Field stations are geographically reachable and the majority of surveyed field stations have dedicated budgets and personnel to support their educational programs. However, there are still obstacles to attracting a broad public audience for informal learning experiences. Fleischner and colleagues (2017) describe time, interest, resources, and risk management as key challenges for colleges and universities offering field courses; these challenges are similar for field stations offering informal learning experiences. Identifying enthusiastic scientists, educators, or volunteers who want to participate in or lead outreach events, carefully planning the activities, recruiting participants, and preparing for or mitigating risk requires effort and dedication by field station leadership. Although not insurmountable, such obstacles can be daunting and require resources to overcome.

In figure 1, we introduced a framework to help field station personnel and others in place-based learning environments improve on their methods and strategies for teaching STEM knowledge in an informal setting by considering connections among place, content, activity, and assessment. Field station personnel can apply the framework to outreach activities to gain perspective on program learning objectives, focus on learning goals of particular activities, and connect those programs and activities to the field stations' overarching outreach goals. Ultimately, the framework serves as a guide for stations in development of their informal STEM education initiatives so that they best meet the needs of learners and other constituents and this in turn could have broader societal impacts.

Educational outreach programs provide opportunities for sizeable numbers of nonscientists to interact with STEM knowledge, the natural environment, and scientists. However, such programs are an underexplored and little recognized resource for informal learning (Klug et al. 2002). A more extensive survey regarding field stations' outreach programs—specifically, how and by whom they are implemented and assessed—would further enrich our findings and provide more insight into the breadth and depth of outreach offerings. Given the close proximity of field stations to a large percentage of the US population and the tremendous wealth of science knowledge that exists at field stations, the corresponding learning opportunities for the general public have great potential. By enabling science educators to engage learners with the strategies that make up the framework (figure 1), field stations create opportunity to extend curriculum beyond the rote material that makes up many standardized exams toward a deeper understanding of science as a process. In an era of science and climate change skepticism, field stations may play a particularly important role in connecting individuals to their local environment and ecosystems. Similarly, given concerns regarding preparedness for STEM careers and meeting the demands of a rapidly changing job market, field stations may come to play an important role in the science literacy of the US population.

Future research needs to investigate how field stations are meeting these challenges and how they fit into the larger, national conversation around science education, informal STEM education, and the value of field stations as providers of educational opportunities. Additional supports for field station personnel are likely needed and can be built from the existing science content knowledge to broaden skills in education and evaluation practices. CAISE finds that "interaction with a STEM professional…is the number one predictor of positive learning outcomes, whether in terms of science learning, increased interest, or the perception that science is fun" (Bonney et al. 2009). Field stations are an excellent venue for bringing scientists together with the public, and a comprehensive mapping of outreach at field stations would help identify which stations have active outreach programs, what strategies are working for them, how they are implementing their activities to engage participants, and what resources are still needed. By compiling this information, the field station community can more easily share best practices for delivering outreach and the informal STEM learning community can better understand what field stations bring to informal education. Such efforts could ultimately provide opportunities for the public to discover science in new and exciting ways.

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Supplemental material

Supplemental data are available at *BIOSCI* online.

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